EVALUATION OF RESULTS OF DAGA INTERLOCKING NAIL IN FRACTURES OF TIBIAL SHAFT

THESIS

FOR

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(ORTHOPAEDICS)

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DEPARTMENT OF ORTHOPAEDICS

M.L.B. Medical College, Jhansi

CERTIFICATE

This is to certify that the work entitled **"EVALUATION OF RESULTS OF DAGA INTERLOCKING NAIL IN FRACTURES OF TIBIAL SHAFT"** which is being submitted for MS (Orthopaedics) examination 2004 of Bundelkhand University, Jhansi, has been carried out by **Dr. MANAV LUTHRA** personally in the department of Orthopaedics, M. L. B Medical College, Jhansi, under my guidance and supervision. The observations were checked by me periodically.

He has put in necessary stay in the department as per university regulations.

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Manav Luthra

DATE: 15th September 2003

MANAV LUTHRA

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INTRODUCTION

INTRODUCTION

Mankind since Stone Age has been inventing ways and means of transportation. Human being has never looked back ever since revolutionary evolution of wheels. Speed has always fascinated man. In his quest for higher speed man has exposed himself to the dreadful vulnerability of various modes of trauma and especially high velocity trauma.

Although trauma is an unavoidable event of life there has been an alarming shift in etiology of traumatic injuries. The incidence of trauma at home, school and work place have decreased because of greater awareness of risk factors and measures to prevent it. On the other hand the increasing rate of highway and sports injuries is alarmingly high in-spite of safety devices. People now a days value time more than they used to do. Industries are also aware of this fact and, thus are producing automobiles, which can accelerate at a faster rate. This has resulted in an increase in rate of accidents per day. More regrettably societies regardless of socio-economic status are becoming more and more violent. Unemployment and growing population have added to the violent behavior of these people. As a result the rate of intentional injuries is also on an increase.

Tibial shaft fractures are devastating injuries that have a tremendous impact on both the society in general and health care system in particular.

NICOLL has aptly stated, " Fracture of tibia shaft are important for two reasons, first is that they are common and the second that they are controversial and anything that is both common and controversial must be importan*t*".

As tibia is a subcutaneous bone, it is quite vulnerable to injury. In-fact it is the most common of the long bones to fracture. Fractures of tibial shaft can be life threatening with open injuries, fat embolism, acute respiratory distress syndrome and resultant multiple organ failure. Due to its subcutaneous location it is prone to infection, due to lack of muscular envelope anteriorly it is also prone to delayed union and nonunion. No fracture in the body has been as controversial as that of tibial shaft in adults. Quite frequently poor functional result and occasionally amputation are the great hazards in complicated cases.

Sir JOHN CHARNLEY has aptly stated, "We still have a long way to go before the best method of treating a fracture of the shaft of tibia can be stated with finality".

NICOLL has also stated that, "Every fracture is an individual problem and the decision to treat it by internal fixation or conservatively should be based on a realistic assessment of the advantages and hazards of each method in the circumstances of that particular case".

The mechanism of injury in a particular case along with comminution, damage to surrounding soft tissues and initial displacement are the most important factors that influence the treatment. However, the treatment becomes more controversial and problematic when high velocity fractures are considered, as they invariably have:

1) Severe displacement of fracture ends.

2) Comminution of varying degrees.

3) Bone defects.

4) Extensive soft tissue damage.

Fracture treatment in general has a tendency to produce enthusiasts for one method or other who are sometimes easily influenced by the good tongue or well written words.

HUGH OWEN THOMAS, 1896, stated that, "If it should to be discovered that I have added one atom to the principle it will give me much more satisfaction than if I should succeed in burdening practice by ingenious means".

Over the years a number of methods have evolved for the management of various types of fractures of shaft of tibia and the surgeon must be aware of the advantages and disadvantages of each to select the proper treatment for each patient. Possible methods include:

a) Conservative methods.

1) Closed reduction and immobilization.

2) Skeletal traction.

3) Cast bracing.

b) Operative methods

1) External fixation.

i) Tubular type.

ii) Ring type.

2) Internal fixation.

i) Intramedullary nailing.

ii) Plate and screw fixation.

iii) Screw fixation.

iv) Encirclage wiring.

SARMIENTO, 1967, was the pioneer proponent of conservative treatment of fracture shaft tibia with closed reduction and plaster immobilization. He stated that most low energy minimally displaced tibial shaft fractures are managed successfully by closed reduction, application of long leg cast and progressive weight bearing. In earlier reports initial plaster was applied with knee in 20°-45° of flexion to control rotation; however this precludes weight bearing ambulation and is no longer recommended.

SARMIENTO has popularized weight bearing ambulatory treatment therefore he recommended that the initial long leg cast be applied with knee in 0°-5° of flexion. As swelling subsides, the cast is exchanged for either well moulded patellar tendon bearing cast or brace for stable fractures or another above knee cast for unstable fractures.

In 1988 **ONI** and associates also described results of patients with tibial shaft fractures treated with a closed, weight-bearing program.

External fixation has been applied primarily to open fractures but there are advocates for its application to closed tibial fracture management. External fixation devices have been devised using titanium or stainless steel wires on smooth or threaded pins that engage the bone supported by an exoskeleton. **BEHRENS,** 1982 and 1986, described two types of fixator, pin fixation and ring fixator. Later hybrid fixators were devised which combine the use of wires and half pins. Complications unique to external fixation are pin track infections and pin loosening.

The most commonly used internal fixation devices used in tibial fractures are plates, screws and intra medullary nails. In general for most diaphyseal fractures of tibia intramedullary techniques are preferred over open reduction and internal fixation with plates and screws.

Numerous authors have reported different types of plates and screws but the AO group refined the approach and instrumentation to its current levels. **RUEDI, WEBBS AND ALLGOWER**, 1976, reported 97% excellent results in 323 closed fractures of tibia treated with dynamic compression plates. **JOHNER, R.** and **WRUHS, O.; 1983,** were others who report good results using compressing plating.

CHARNLEY, in his text "closed treatment of common fractures" stated that he believed the eventual solution to the tibial shaft would be unreamed intramedullary nail. **HOOPER. G.J.** and colleagues 1991 performed a randomized trial on matched groups of 62 patients with displaced tibial shaft fractures to compare conservative treatment with closed intramedullary nailing. **LOTTES, J.O.,** 1952 was one of the earliest proponents of unreamed intramedullary nailing using his triflanged nail. **PUNO, R.N.,** and colleagues 1986, **BONE, L.B., AND JOHNSON, K.D.,** 1986, **KLEMM, K.W., AND BORNER, M.,** 1986, were others to work on intramedullary nailing.

Every treatment method has its advantages and disadvantages but to suit Indian conditions a different nail was designed by **DR. K.P. DAGA** (1988) of Sholapur known as 'D' nail or Daga interlocking nail. He kept the slogan as

"SIMPLICITY IS OUR STRENGTH IN ALL RESPECTS"

This nail is stronger, providing better three point fixation with interlocking facility, relatively cheap, easily available and does not need special instruments. It also stands better in way of torsional and bending forces than standard 'V' nail.

DR. DAGA has operated many patients with tibial shaft fractures of various configurations and results are very encouraging and convincing.

AIMS & OBJECTIVES

AIMS AND OBJECTIVES

Various studies have been conducted in the past to document the superiority of one or other methods of treatment for the tibial shaft fractures with variable results. Keeping these studies in mind the following study was conducted with following aims and objectives:

1] Etiology of tibial shaft fractures in Bundelkhand region.

2] Role of Daga interlocking nailing in tibial shaft fractures.

3] To evaluate the result of D nail in fracture shaft of tibia.

REVIEW
OF
LITERATURE

REVIEW OF LITERATURE

Orthopaedic surgery is an ancient art. A detailed account of treatment of a fracture is found in the writing of **HIPPOCRATES**, (4^{th} century BC) the father of medicine. A similar description is also found in ancient Indian medical literature on injury to bones and joint by **SUSHRUTA (600BC)**.

Fractures were immobilized by **ALBACUSIS and AMBROISE PARRE** in 1776 by bandages made stiff with egg albumin, starch, gum etc., until 1852 when a Flemish military surgeon **ANTONIUS MATHIJSEN** used the plaster of paris bandages for the fracture immobilization. Early Orthopaedic surgeons such as **SENN, LAMBOTTE AND HEY GROVE** investigated the used of ivory, bone and metal nails.

WISS et al, 1986 suggested that fractures from 7.5 cm below the knee to 7.5 cm above the ankle, with at least 25% cortical opposition could be treated with ender pins.

DOBOZI, W.R.; SALTZMAN, M.; and BRASH, R. 1982 reported that 25 of 26 fractures treated with ender pins united without infection.

PANKOVICH, A.M.; TARABISKY, I.E.; and YELDA, S. 1981 reported their results in 37 fresh tibial fractures (28 simple,

eight compound and one gunshot wound) fixed with flexible intramedullary nails.

Although all current intramedullary nailing techniques, like other surgical procedures have been evolved from earlier surgical operations, the intramedullary techniques that are in common use today have been derived mainly from the work of **GERHARD KUNTSTCHER** (1940, 1958, 1976) in Germany and the **RUSH** (1955) in USA. **KUNTSCHER IS UNQUESTIONABLY THE FATHER OF REAMED INTRAMEDULLARY NAILING**.

Together with **POHL**, 1940 a metallurgist and an instrument maker, **KUNTSCHER** produced a series of nails with a V-shaped profile, made of corrosion resistant steel. Subsequently he invented a number of nails of different shapes culminating in his design of a slotted nail with a cloverleaf cross-section. The nail gained worldwide acceptance and is the basis for the design of many modern intramedullary nails. Initially, he developed a nail with a double V-cross-section, but the results were poor. **HERZOG 1951**, however used **KUNTSCHER'S** femoral nail with a cloverleaf cross section and stated that it is suitable for tibia.

KUNTSCHER 1958 believed that enlargement of the medullary canal by reaming was of greatest importance in the practice of intramedullary nailing.

He felt that reaming the endosteal surface of cortex is important for three reasons:

- It permitted the insertion of a nail of sufficient thickness to take over the function of the bone.
- It increased the area of endosteal contact made by the nail.
- It allowed an accurate fit between the nail and the reamed part of the endosteal cortex.

He also believed that the technique provided favourable conditions for callus formation and was not only simple to undertake but can also be applied to many common fractures.

Many of the problems with intramedullary nailing techniques of the tibia are related to the portal of entry and insertion of the nail, because of the offset of the proximal tibial articular surface Intramedullary nails have a tendency to perforate the posterior cortex. If the nail is left too long it will irritate the patellar tendon and cause difficultly with knee motion especially with kneeling. **LOTTES** (1952) changed this approach to allow more medial position of the nail and **HERZOG** (1951,1974) modified the **KUNTSCHER NAIL**

by adding a proximal angulation to aid insertion of the nail. **LOTTES** (1954) was one of the earliest proponents of unreamed intramedullary nailing using his triflanged nail.

SLATIS, P. & ROHANEN, P., (1967) stated that better subtalar motion was obtained after intramedullary nail fixation than after cast immobilization. Russel Taylor Delta tibial nail was used by **HENLEY, M.B.** and associates (1989) and **WHITTLE, A.P.** and co workers (1992). They showed acceptable rates of union and decreased rate of infection in open fracture of the tibia.

KUNTSCHER (1967) considered that for successful fracture fixation, the incision should be as far from the fracture as possible. He thus also pioneered the concept of closed reamed intramedullary nailing. To achieve this and to adhere to his philosophy of accurate reaming, he invented flexible guided reamers. His reamer design has been adopted over the years and closed reaming has become an essential part of closed nailing of both femur and tibia. Successful closed nailing also requires the use of image intensification to allow imaging of the fracture at all times during surgery. These techniques were also largely pioneered by **KUNTSCHER.**

At about the time **KUNTSCHER** was developing the reamed intramedullary nail, **LESLIE.V. RUSH** was pursuing the concept of

the unreamed nails, thus he developed the Rush pin. The pins are used singly or in pairs to achieve fracture stability and stability depends on three-point fixation of fracture.

In 1970, **KLEMM & SCHELLMAN** developed the KUNTSCHER DETENSOR NAIL and instrumentation for insertion, extraction and locking of nail.

In the early 1970's **ARSEN GROOSE**, a trauma surgeon in Transbourg (France) began using the Klemm nail. He was fascinated by the concept of the LOCKING KUNTSCHER NAIL and he felt that the design could be improved. This led to the development of another version of the locking Kunstcher nail, the Grosse Kempf nail similar in design to the AO nail.

In 1970's and 1980's **HAMZA, K.N.; DUNKERLY, G.E. AND MURRAY, C.M. 1971** and **BONE, L.B. & JOHNSON, K.D. 1986** reported unacceptably high infection rates (13.6%-33%)in small series of open tibial fractures treated with reamed nailing. These reports led to the belief that medullary reaming is contraindicated in open tibial fractures, particularly Gustilo grade II and grade III types.

Animal experiments by **KLIN et al** and **SCHEMITSCH et al** demonstrated that insertion of reamed nails disturbs cortical blood

flow to a greater extent than does insertion of unreamed nails, possibly increasing the susceptibility to infection.

Like the AO nail, the GROSSE-KEMPF nail has a cylindrical proximal section with an internally threaded segment that permits attachment of both driver and target device. **GROSSE & Co-workers** 1976 published their first report in 1976. Since that time, use of both versions of the **LOCKING KUNTSCHER NAIL** had been spreading steadily through various centres at Europe and North America.

In 1977, **GROSSE AND KEMPF** improvised the nail and devised a distal locking device which could be attached to C-ARM of image intensifies. This increased the use of locking as a routine procedure.

KEMPF, GROSSE AND CO-WORKERS (1986) reported 66 cases of non-infected nonunion (27 femoral and 39 tibia) treated with an interlocking nail. In these cases 92.6% of femur and 94.8% of the tibia healed after the first operation in a mean time of 15.4 and 13 weeks, respectively. Deep infection complicated five nailings (7.5% to femur and 3% tibia), which included three patients with reactivation of latent osteomyelitis. All cases healed after debridement and use of gentamycin PMMA beads. Residual angulation between 5-10° occurred in three femurs and seven tibia.

Shortening occurred in all patients and average 0.9cm in the femur and 0.5cm in the tibia. In patients with tibial non-unions treated with a locked nail 92.3% had normal knee flexion and 84.6% obtained normal ankle function. The advantages to the patient with femoral or tibial shaft pseudoarthrosis are that the technique allows, early weight bearing, range of motion of adjacent joints and reliable rates of consolidation of the non-unions.

Interlocking nail, initially of **KUNTSCHER** design was modified by **KLAUS, KLEMM, BORNER and others** (1986).

KLAUS, W.; KLEMM AND BORNER (1986) reported 401 tibial fractures, 308 closed and 93 grade I open (delayed nailing), 81% of fractures were potentially unstable (comminuted, segmental, spiral or fractures with a butterfly fragment); 77% were nailed in a static locking configuration. Closed nailing was possible in 98% of fractures. Of 267 fractures reviewed, 94% had excellent or good results. Complications developed in 20 patients (5%) following interlocking tibial nailing. In two patients, unstable osteosynthesis required a plaster cast, one patient developed compartment syndrome which required, fasciotomy; peroneal palsies were noted in three patients, delayed union was also noted in three patients which required bone grafting. In two patients the nail broke. There was 2.2% deep infection rate, which responded to treatment without

osteomyelitis. Delayed union or nonunion requiring bone graft occurred in 7% cases. They opined that CLOSED INTERLOCK NAILING of the tibia is treatment of choice for closed diaphyseal fractures of the tibia in the skeletally mature individuals. Delayed interlocking nailing can be used safely effectively in most grade I open fractures.

MILLER, M.E. & CO-WORKERS (1955) reported 19 infected non-union and delayed union of tibial fractures treated with locked intramedullary nailing combined with open wound management. Eighteen of 19 fractures united. Drainage lessened or ceased after union of fractures and or removal of nails. All were initially type III open fractures. The majority occurred in vehicular accidents. Time to union averaged 6.6 months (range 3-14 months). Fourteen cases (15 tibia) healed without further drainage four had minimal but persistent drainage. They opined that treatment was safe and effective in properly selected cases.

Intramedullary devices in various forms have been used for many years to stabilize long bone fracture. It is recorded that **AZTECS** used wooden intramedullary nails 500 years ago (**HAEGER K the illustrated history of Surgery, 1988**)

ERIC, E.; JOHNSON; SIMPSON, L.A. AND HALFET, D.L. 1988 reported 16 tibial fractures, three segmental, treated initially with external fixation and secondarily with delayed intramedullary nailing after fixator removal. The average patient's age was 40 years (range 19-84 years). The external fixator was removed at an average of 12 weeks (range 3 to 25 weeks). Intramedullary nailing was performed at an average of 13 days after fixator removal. All fractures healed with bridging callus; full weight bearing occurred at an average of 27 months. Results were rated as excellent in eight and good in five. There were no complications related to infection or non-union. They concluded that delayed intramedullary nailing, after excluding potential high-risk patients, is an option for treatment of tibia fractures that have failed treatment with external fixation. However, they cautioned that it is not recommended as a routine procedure.

Recent work by **STRACHAN** et al (1990) using radioactive labelled microspheres suggested that the importance of the medullary blood supply and nutrient artery supply in long bone diaphysis have been exaggerated. They stated that it is the periosteal blood that is important and they opined that the periosteal bloody supply reserve is so great that it will more than compensate for any damage to the medullary supply.

The advantage of using unreamed nail is that the medullary blood supply is less traumatized than if it is reamed out prior to nail insertion. This theory may be correct but the success of reamed locked nail in healing both femoral and tibial fractures suggest that the intramedullary blood supply may be only one parameter that effects bone union **(CM Court Brown, 1990). RHINELANDER, F.W. (1968)** demonstrated a rapid regeneration of the nutrient artery system in fractures stabilized with loosely fitting nails and **ROND** et al (1977) showed a greater over all blood flow in nailed dog ulnar osteotomies than occurred after plating.

Locked intramedullary nailing of open tibial fractures by **COURT BROWN, C.M.; MCQUEEN, M.M.; QUABA, A.A.** AND **CHRISTIE, J. (1990)** reported the use of Grosse-Kempf reamed intramedullary nailing in the treatment of 41 GUSTILO TYPE-II and III tibial fractures. The union time and infection rates were similar to those previously reported for similar fractures treated by external skeletal fixation but the incidence of mal-union was less and fewer required bone grafting.

ROSSON, J.W. AND SIMONIS, R.B., (1992) treated 24 patients with non-union of tibial shaft fractures by locked intramedullary nailing, 18 by open and six by closed techniques. Union was achieved in 22 patients failing only in two patients with

active infection, locked nailing prevented recurrence of deformity and allowed the patients to mobilize without external support. Supplementary bone grafting was essential only for major defects.

O'BEIRNE, J.; SEIGNE, P. and McELWAIN (1992) treated 37 tibial shaft fractures in 34 patients with Grosse-Kempf interlocking intramedullary nail over a two-year period. Thirty-six tibial fractures were consolidated at a medium of 17 weeks; One had re-fracture following nail removal in a separate injury, but was now uniting on conservative treatment. Using very detailed clinical and radiological analysis and excluding the patients who had re-fractured, the results were excellent in 19, good in eight, fair in six and poor in three. The most significant complications were haematoma formation and additional comminution during nail insertion. Overall they found tibial nailing to be a satisfactory procedure, facilitating rapid re-habilitation with early weight bearing and resulting in predictable fracture healing in good alignment.

WHITTLE AND CO-WORKERS (1992) reported 50 open fractures of the tibial shaft treated with debridement and interlocking nailing without reaming, using Russel-Taylor Standard Tibial or Delta Tibial nails. 60% of the fracture wounds were Grade III. 96% of the fractures united at an average of seven months; there were no malunions. There were four infections (8%) all at the site of Grade III

fractures. Locking screw broke in five (10%) tibia. Three nails broke, two at the sites of united fractures and one at the site of healed fracture. The results were better than those obtained with other forms of fixation, including immobilization with a cast, unlocked intramedullary nailing and external fixation.

Locked nailing for treatment of delayed healing of fracture of femur and tibia was done by **KRUSCH-BRINKER R et al**. 1993. They found that locked nailing of tibia is not indicated in patients with a history of infection. A change of method of treatment after plate osteosynthesis or external fixator can be performed in one stage for the femur but should be done in two stages in lower leg for protection of soft tissue. Nailing is preferably done in closed manner. A cancellous graft is usually rendered unnecessary by the osteogenetic potency of the graft obtained by reaming.

LUCAS AND CO-WORKERS (1993) studied treatment with locked intramedullary nails in fractures and non-unions of tibia. They have treated 107 tibia, 94 with fresh fractures and (13) with noninfected nonunion using Grosse-Kempf Nail. After analysis they considered:-

- Stable fractures treated with dynamic nails and static nails may be allowed easily weight bearing.

- Avoid performing distal dynamic nailing; if there is a doubt, it is better to choose a static nail.
- Closed fractures with severe soft tissue injuries must be treated as open fractures.
- The method is a good option from the point of view of early rehabilitation and few complications.
- This method is indicated in non-infected, non-unions and closed fractures or open Grade I or II, unstable fracture, which does not allow conservative treatment.

LAMAIRE, RONDIA, GILLET (1993) studied on unlocked-reamed nailing for pseudoarthrosis of the tibia and concluded that unlocked reamed nailing is an effective treatment application to numerous pseudoarthrosis of tibia shaft. Locked nailing is probably preferred in order to avoid immobilization in plaster for cases with axial on rotational instability; in about $1/3^{rd}$ of cases a history of infection, however transient, indicates that a different mode of treatment is required.

The place of locked intramedullary nailing for distal tibial fractures was researched by **SAMARAN, et al (1993)**. They concluded that locked intramedullary nailing usually gives good

results in supra-malleolar fracture where the fracture line is as close as 3cm from the joint space.

Intramedullary nailing; without reaming after external fixation of open tibial shaft fractures was done by **ROECK AND CO-WORKERS (1993)** in 23 open tibial shaft fractures. This study demonstrated that provisional external fixation followed by intramedullary nailing without reaming is a good treatment option for type II and Type IIIa open tibial shaft fractures, provided intramedullary nailing is delayed until healing of the soft tissue has been obtained.

R VANDER GRIEND (1993) studied the effect of unreamed intramedullary nail on tibial blood supply and found that metaphyseal blood in the proximal and distal tibia was minimally affected by the unreamed nail. The medial cortex was affected more than the lateral or posterior cortex and these changes were even greater in areas where the unreamed nail completely filled the intramedullary canal. Unreamed nail do alter the interosseous vascularity of the human tibia especially in the diaphysis. The pattern of impairment of the circulation was similar to that described with use of reamed intramedullary nail.

Recently **KEATING et al,** 1998, reported a randomized, prospective study comparing reamed and unreamed locked tibial nailing of open tibial fractures. Forty-seven of the nails were inserted after reaming and 41 without reaming. The average time to union was 30 weeks for reamed and 29 weeks for unreamed nailing. Nine percent of fractures treated with reamed nailing did not unite; compared with 12% of those treated with unreamed nailing. Nail failure occurred in two reamed nailing and one unreamed nailing group (2.4%).

WU, C.C. AND SHIH, C.H. (1993) observed the effect of dynamization of a static interlocking nail on fracture healing. A retrospective study was done. Eleven patients were treated with static interlocking nailing followed by dynamization, which was carried out on an average 7-8 months later. The success rate was 54%. The follow up was at least two years. The interval from nailing to dynamization did not correlate with success rate. They found that static interlocking without dynamization can still produce a high union rate and if there is sparse callus formation during the healing process, indicating low osteogenesis, dynamization will result in fracture union in only half the cases. To improve the union rate, cancellous bone grafting may be necessary.

PAUL TORNETTA and others (1994) reported the early results of randomized, prospective study comparing external fixation with non-reamed locked nails in Grade IIIB open tibial fractures. Of 27 patients; fifteen were treated by nail and 14 by external fixation. Both groups had the same initial management, soft tissue procedures and early bone grafting. All 29 fractures healed within nine months, but the nailed group had slightly better motion and less final angulation. Complications included one deep infection and two pin track infection in the external fixator group and one deep infection and one vascular problem in the nailed group. They found that nailed fractures were consistently easier to manage, especially in terms of soft tissue procedures and bone grafting. It is the treatment preferred by patients and does not require the same high level of patient compliance as external fixation. The only factor against nailing was the longer operating time and the greater need for fluoroscopy. They considered that locked unreamed nailing is the treatment of choice for grade IIIB open tibial fractures.

TANNA, D.D. (1994) reported a method of tibial interlock nailing without image intensifier. As in India, 95% of the hospitals do not have image intensifier, so in these circumstances, unreamed locked tibial nailing was done using hollow tubular nails with no slit and anteroposterior holes for the locking screws. In six early cases

locking had to be abandoned because the holes could not be found, but in all the last 50 cases good locking had been achieved. The average time for procedure was 1.5 hours.

CHRISTIAN KRETTEK AND OTHERS (1995) reported 21 closed tibial shaft fractures with severe soft tissue trauma (Grade II and III) treated with unreamed interlocked nailing. All fractures healed in an average time of 23 weeks (range 10-44 weeks). Three patients required bone graft and in three patients the fixation was revised. Because of the low infection and low nonunion rate, they recommended unreamed interlocking tibial nails for closed tibial shaft fractures with severe soft tissue trauma.

R KYLE (1997) studied biomechanics of intramedullary nailing, controversies in reamed versus unreamed nails and techniques and physiology of reaming.

SLEDGE, S.L. and others 1989 treated non-union of eight femoral and 15 tibial and one both tibial and femoral fracture with reamed intramedullary nailing without bone grafting and concluded that intramedullary locked nailing is the treatment of choice which permits early mobilization and weight bearing. It is preferred against stable fixation with plating and screws.

LAMBIRIS, E.; ZOUBOULIS, P.; et al (1997) did locked intramedullary nailing in 675 femoral and 399 tibial fractures and concluded that according to AO classification of femoral and tibial fractures:

- For Type A → Dynamic Interlockking nailing is treatment of choice while
- Type B except B_1 and Type C static interlock nailing in the treatment of choice.
- Open fracture (grade I) may be treated with interlock nailing especially if it performed without any serious complications. Locked intramedullary nailing may be the treatment of choice when other methods failed.

LANGLAIS, THOMAZEAU, DUJARDIN (1997) devised endolock interlocking nail, in which, insertion avoided irradiation of the surgeon's hand (which is excessive with the usual "Free Hand" distal screws targeting). It interlocked the femur by an element, which, unfold from the nail to cortex and therefore do not require the irradiation exposure.

MARCHETTI et al (1997) designed a nail, which was called "Universal Elastic Nail" in fixation of long bone fractures and nonunion. The nail is introduced without any reaming.

McGRAW, J.M. and LIM, E.V. treated 48 open tibial fracture with external fixation and secondary intramedullary nailing and concluded that intramedullary nailing can be viewed as the treatment of choice for open tibial fractures of type I and II and provides satisfactory results.

Delayed AO reamed nailing was done by **WISNIEWSKI (1997)** in 60 open tibial fractures and concluded that this approach to the management of open tibial fracture is both safe and reliable.

BURGESS, A.R. et al did IM nailing (Locked Russel Taylor Nail**)** as a primary treatment for 17 open tibial fractures followed by debridement of wound and pulse lavage. They strongly believed that intramedullary nailing has a place in management of grade I open tibial fractures. Early management was essential for successful outcome.

The risk of infection in locked intramedullary nail in fractures of tibia shaft was observed by, **JY JENNY, SCHLEMMER, G JENNY (1997) in** 1009 cases. They concluded that locked intramedullary nailing of tibial fractures with reaming as an emergency does not have a greater risk of infection than other methods of internal fixation even in open fractures. Taking into account the well known mechanical qualities and advantages as regards bony union and early functional

rehabilitation, it seems to be the best method which can be used in principle for closed fracture and grade I and II open fractures. For grade III fractures nailing should not be considered except in selected cases combined with early flap coverage of the wound.

SCHANDELMAIER, C. et al 1995 did a study to compare interlocked unreamed nailing with external fixation of 96 open tibial fracture and described a very simple method to place the distal screws of the interlocked nailing. They concluded that unreamed tibial nailing with proper surgical technique seems to be a better alternative than external fixation.

ALHO, A. et al utilized AO unreamed tibial nail with or without intra-articular involvement in 45 tibial fractures. They concluded unreamed nailing produces a biological fixation with no harm done to the endosteal vascular supply. The narrow diameter of nail enables the percutaneous insertion of additional inter fragmentary screws.

RIEMER, B.L. et al did intramedullary nailing of 88 closed and nine type-I open tibial fractures. Eighty-one Russel Taylor nails and 16 AO unreamed nails were used. Union occurred in 10, sepsis in four, valgus deformity in 14, significant knee pain in 9 patients was found. There were no neurovascular damage. Of the employed patients 82% returned to work.

JERSINOVICH, J. et al used a titanium unreamed nail for nineteen open tibial fractures. Average time of radiological consolidation was 8.8 months. Malunion was reported in one patient. There was no case of nonunion. Range of movement of knee in 90% and of ankle in 84% returned. 83% of patients were able to return to their work.

BLACHUT, P.A.; O'BRIEN, P.J.; MEEK, R.N. VANCOUVER, BRITISH COLUMBIA, CANADA (1990) have studied 152 patients who had 154 closed fractures of the shaft of the tibia. They were prospectively randomized to management with interlocked intramedullary nailing. Seventy-two patients (73 fractures) who had been managed with nailing without reaming were available for follow up at an average of 12 months post operatively. Seventy fractures were treated with reaming and 56 without reaming united without need of additional operation. Only one developed deep infection after unreamed operation. After reaming one nail broke. A screw fractured after two procedures. Malunion occurred in three with reaming and in two without reaming, four malunion were of very proximal fracture and one of very distal fracture. Neither of these prevalence was significantly different in nail removal. They concluded that there are no major advantages to nailing without reaming as compared to nailing with reaming for closed fracture.

There was a higher prevalence of delayed union after nailing without reaming.

PRASAD CVRO, SULLIVAN M, MC CARTHY P (1998) did a CT assessment of torsions following locked IM nailing of tibial fractures. They concluded that malrotation upto 15° was not apparent and did not correlate to the amount of comminution or the level of fracture and malrotation that is clinically not obvious occurs in significant number of patient undergoing this operation in spite of careful alignment during surgery.

McNALLY, SINCLAIR, SMALL AND Y TEATES (1998) did primary stabilization and free flap cover for 17 grade IIIB open fracture of the tibia. They demonstrated that provision of a healthy soft tissue envelope produces good functional results without high infection rates. The need for secondary bony procedures highlights the difficulties with bone union and these should be planned and performed early.

DAGA NAIL CONCEPT

"Simplicity is our strength in all respects"

In 1988 **PROF. KP DAGA** of Solapur designed the nail for tibial shaft fractures with the head at its top and cloverleaf cross-section without any holes for interlocking screws and then in 1990 three

locking holes were added to design. When seen that more holes made the nail weaker he changed to two holes. After doing 200-250 cases he found that occasionally the nail used to bend more and break at proximal hole of the two especially when the interlocking screw was not passed. He then switched to only one interlocking hole in 1994. The tapering lower end is present since its' beginning. Since 1994 there is provision for upper interlocking hole through eye if wanted, for the static nailing in the very badly and severely comminuted fractures, as principally one should fix interlocking screw in the smaller fragment only; in dynamic nailing. In Indian patients only one hole and only one screw of 4.5mm or 3.5mm is quite sufficient to bear the weight. **DR. DAGA** states that making the patients stand next day or same day after six hours of operation has helped the union to occur earlier there is 0% chance of interlocking screw breakage in-spite of the immediate weight bearing.

According to him the patients have started during motor cycle on 10^{th} day and have gone back to their duties just within 4-6 weeks and thus saved anticipated loss of working hours of the patients and thus helping national economy.

MATERIAL
&
METHODS

MATERIAL AND METHODS

This study was undertaken in the Department of Orthopaedics, Maharani Laxmi Bai, Medical College & Hospital, Jhansi, during the period November 2001-May 2003

Selection of patients:-

Patients with fracture of tibia between, 5cm distal to the tibia plateau & 5cm proximal to ankle mortise regardless of fracture configuration were subjected to this study.

Selection criteria:-

1. Displaced comminuted or non-comminuted fractures of tibia shaft at any level 5cm from upper end of tibia to 5cm proximal to the lower border of tibia.
2. Segmental fractures of tibia shaft.
3. Unstable fractures.
4. Group I, II, IIIA compound fractures of tibia.
5. Poly-trauma patients.

PRE OPERATIVE MANAGEMENT

The patient will be thoroughly assessed by clinical radiological & laboratory examination with regards to: -

1. Detailed history with special attention to mode of injury, duration of injury, associated injuries & treatment taken if any.
2. General & systemic examination of the patient.
3. Local examination of the affected limb with special attention to the condition of skin, soft tissue & neuro-vascular status.
4. X-ray of affected leg; antero-posterior & lateral view to know the configuration of fracture.
5. Investigations: Complete Blood Count, urine: routine & microscopy, Blood sugar, Blood urea & Serum creatinine.

In preoperative management patient was put on a posterior above the knee plaster of paris slab if the fracture is closed. If dealing with an open fracture a through debridement along with antibiotic and above the knee posterior plaster of paris slab.

OPERATIVE TECHNIQUE

Anaesthesia: - General/ Spinal/ Epidural Anaesthesia as necessary.

Positioning: - patient is laid supine on operation table with knee of the affected extremity bent at 90° & hanging free from the edge of OT table

Operative steps

- A premeasured D-nail in put on medial surface of leg for confirmation of the length of required nail.
- As anteromedial entry gives better three point fixation therefore anteromedial curvilinear incision is made at the level of tibial tuberosity .
- A window is created or an entry portal is created with the help of bone awl after separation of soft tissues & periosteum.
- A thin 'v' nail (6 mm or 7 mm) is passed to judge the direction of medullary cavity of tibia for some distance & taken out.
- A 'D' nail is inserted and advanced gradually with gentle blow of mallet & the fracture is reduced & nail is advanced further. The stability of reduction is judged by rigidity & immobility of the fracture site. The direction of the eye is controlled with the use of an artery holding forceps.
- An X-ray is taken at this stage to confirm the adequacy of reduction; proper distal placement of nail; & the orientation of eye.
- Three hypodermic needles are put up till the bone distally to match the eye of the inserted nail with the help of an external master nail or a nail of same size & another X-ray is taken.

- After confirmation a small nick is taken over the skin on the position of needle, preferably away from fracture site. After exposure of bone, a drill hole is made with a 3.2 mm drill bit in the anterior cortex of tibia & guide wire with T-handle is passed to locate the eye of the nail. Again after confirmatory X-ray the posterior cortex is also drilled. After tapping a 4.5 mm cortical screw of appropriate length is inserted in the hole.
- Upper end or platform of 'D' nail is buried in the window. The upper border should abut against the upper border of the window. The wound is closed in layers over suction drain & final x-ray is taken.

POST OPERATIVE MANAGEMEN

1. The limb is elevated & antibiotics & analgesics are given.
2. Ankle & knee mobilization exercise are started on the second post op day.
3. In stable fracture configuration graded & partial weight bearing is started as soon as pain tolerance of the patient permits.
4. Full-unprotected weight bearing is not allowed till solid union occurs.

5. Patients are followed at four weeks interval for progress of the case under the following heads.

A] CLINICAL

a) Range of movement at knee & ankle.

b) Pain at fracture site.

c) Muscle atrophy.

d) Deformity if any.

e) Shortening if any.

f) Evidence of infection either superficial or deep if any.

B] RADIOLOGICAL

a) Status of union.

b) Deformity.

c) Status of screws and nail.

EVALUATION OF RESULTS

The results of DAGA interlocking nail fixation in fracture shaft tibia are evaluated under the following headings.

Evaluation of results (according to Prof KP Daga)

1	**Excellent**	• No post operative complications • Normal function with full range of knee and ankle movements • No infection
2	**Good**	• Minor post operative superficial infection • Normal function • No other complication
3	**Fair**	• Mild pain at fracture site • Some restriction of knee and ankle movements less than 10° angulation • Shortening <1cm • Negligible deformity, less than 10 degree angulation
4	**Poor**	• Deep infection • Bending or breaking of nail • Non union • Marked restriction of movements • Shortening >1cm • Deformity > 10° angulation

OBSERVATIONS

OBSERVATIONS

This study was carried out in 10 patients in the Department of Orthopaedic Surgery, MLB Medical College & Hospital, Jhansi.

Those patients having fracture of tibial shaft were treated by DAGA intramedullary interlock nail & following observations were made.

TABLE – I

AGE DISTRIBUTION

Age group	No of patients	Percentage
< 20	2	20%
21-60	8	80%
> 60	0	00%

Age group of patients varied from 16 years to 55 years and the mean age in present series is 31 years.

TABLE – II

SEX DISTRIBUTION

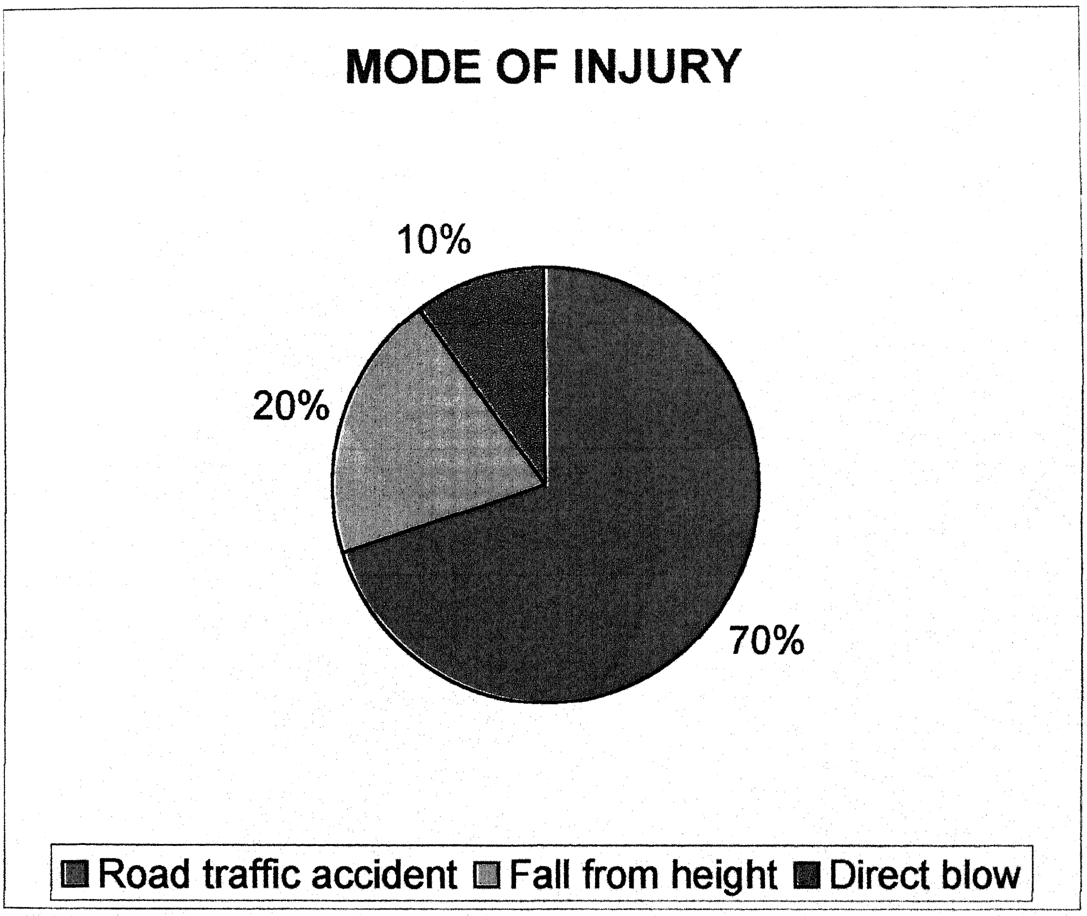
Sex	No. of patients	Percentage
Male	8	80%
Female	2	20%
Total	10	100%

In present study 80% percentage of the patients were male & only 20% were female patients.

TABLE – III

Mode of injury	No .of cases	Percentage
Road traffic accident	7	70%
Fall from height	2	20%
Direct blow	1	10%
Total	10	100%

Majority of cases were caused by road traffic accidents. Fall from height & direct blow were other causes of the fracture.


MODE OF INJURY
10%
20%
70%
Road traffic accident
Fall from height
Direct blow

MODE OF INJURY

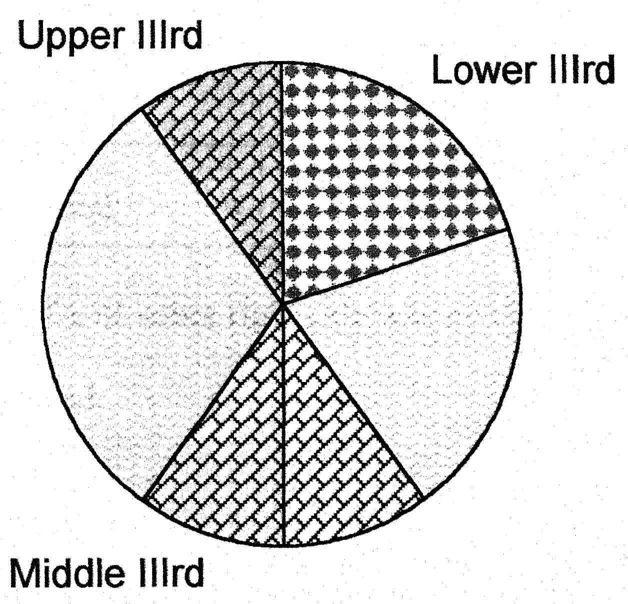


TABLE – IV

SIDE OF INJURY

Side	No. Of patients	Percentage
Right	6	60%
Left	4	40%
Total	10	100%

In 60% of cases right side was involved & in 40% of cases left side was involved.

TABLE – V

TYPE OF FRACTURE CLOSED OR OPEN

Type	Number of patients	Percentage
Closed	6	60%
Open	4	40%
Total	10	100%

In our study 60% were closed fracture & 40% were open fractures.

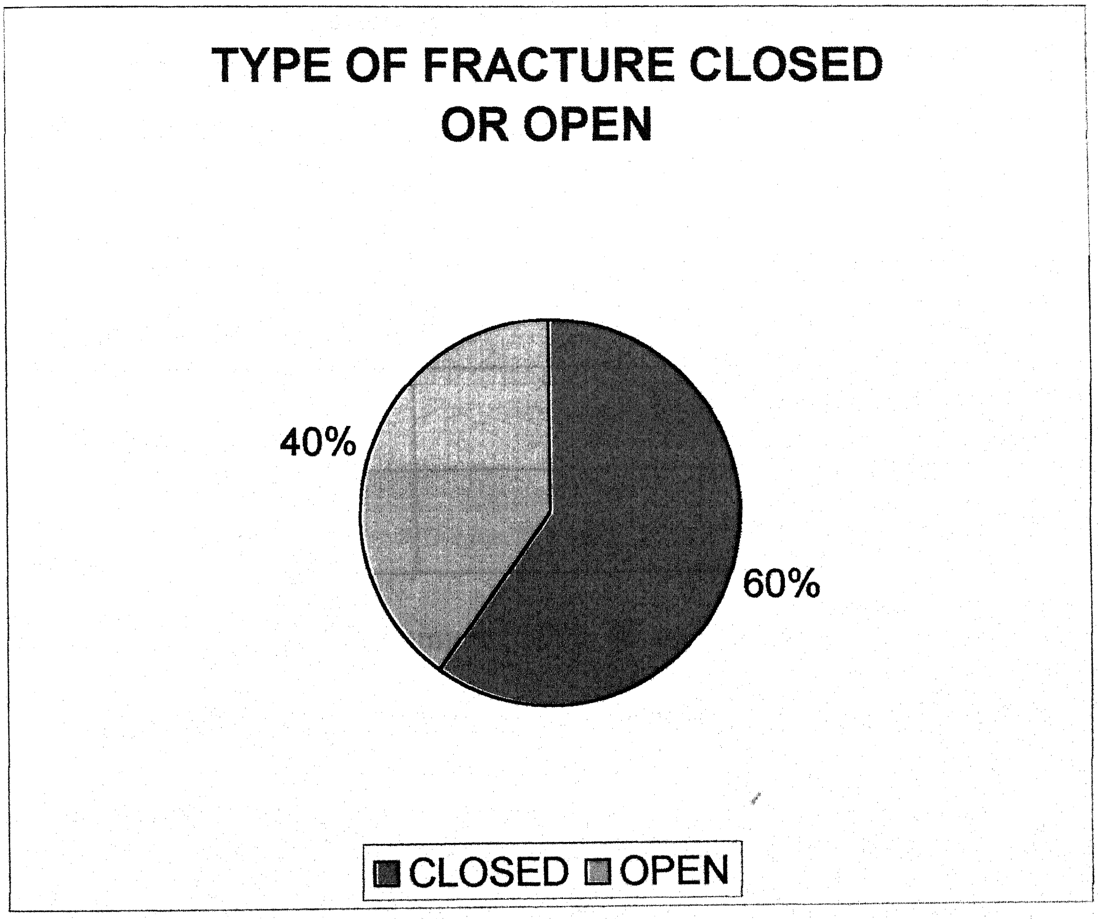

TYPE OF FRACTURE CLOSED
OR OPEN
40%
60%
CLOSED
OPEN

TABLE – VI

RADIOLOGICAL TYPE OF FRACTURE

Radiological type	Number of patients	Percentage
Transverse	3	30%
Comminuted	5	50%
Oblique	2	20%
Total	10	100%

In our study maximum 50% of cases were having comminuted fracture while 30% of fractures were of transverse type & remaining 20% of oblique type.

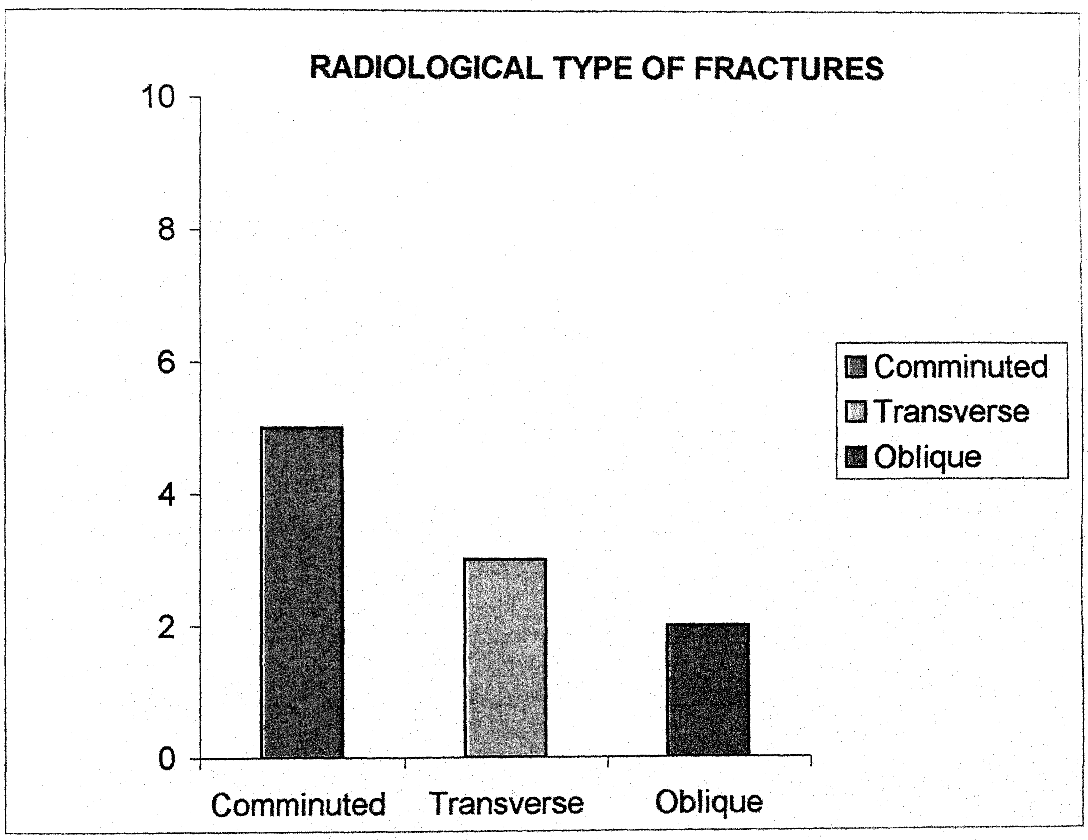

RADIOLOGICAL TYPE OF FRACTURES
10
8
6
4
2
0
Comminuted
Transverse
Oblique
Comminuted
Transverse
Oblique

TABLE - VII

SEGMENT OF BONE INVOLVES

Segment involved	Number of patients	Percentage
Upper 1/3 rd	1	10%
Middle 1/3 rd	4	40%
Lower 1/3 rd	5	50%
Total	10	100%

50% of cases had fracture in lower 1/3 rd of tibia 40% had fracture in middle 1/3 rd while in 10% only upper 1/3 rd of bone was involved.

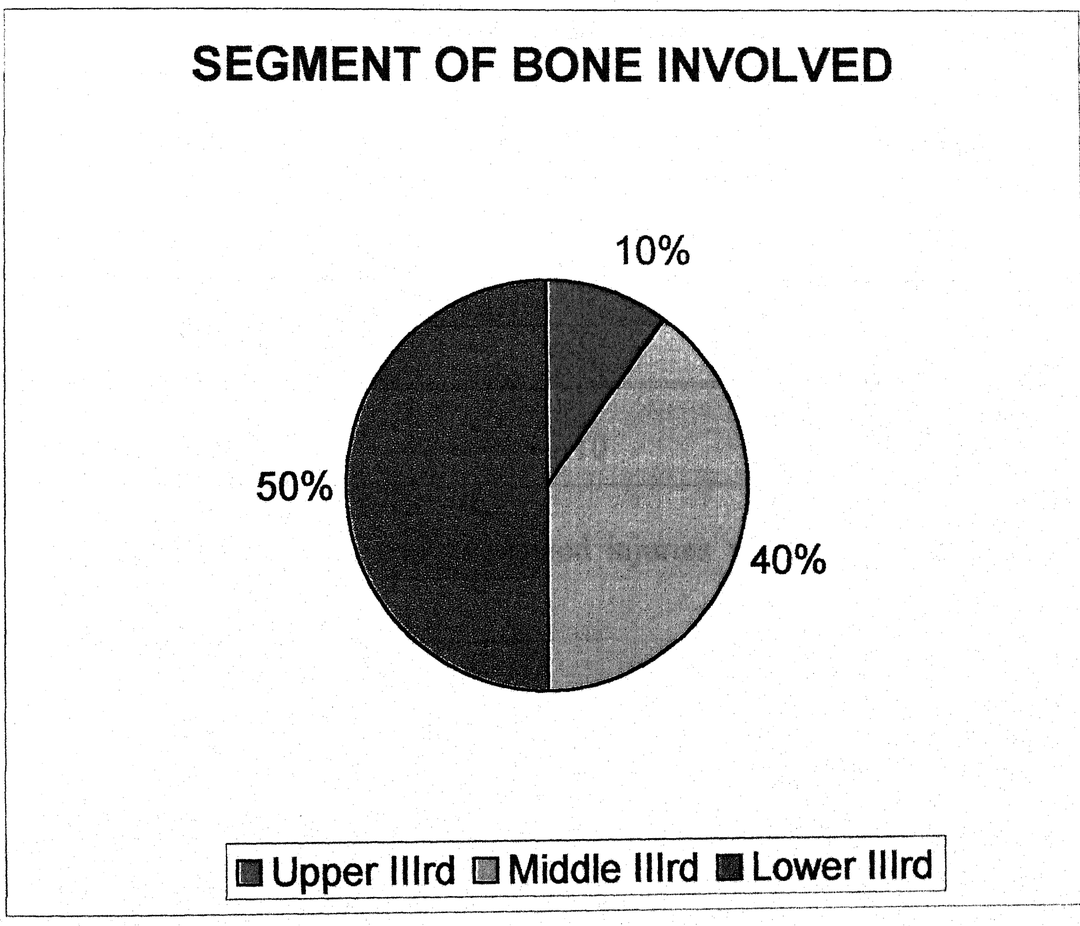

SEGMENT OF BONE INVOLVED
10%
40%
50%
Upper IIIrd
Middle IIIrd
Lower IIIrd

TABLE – VIII

ASSOCIATED INJURIES

Associates injury	No. of patients	Percentage
Present	3	30%
Absent	7	70%
Total	10	100%

30% of patients had associated injuries while 70% had fracture of both bone leg.

TABLE – IX

PREOPERATIVE DURATION

Preoperative duration	Number of patients	Percentage
< - 7days	2	20%
7- 14 days	6	60%
14-21 days	1	10%
> - 21	1	10%
Total	10	100%

80% of patients were operated within two weeks of injury while 10% of patients were operated in third week & 10% of patients preoperative duration was more than three weeks.

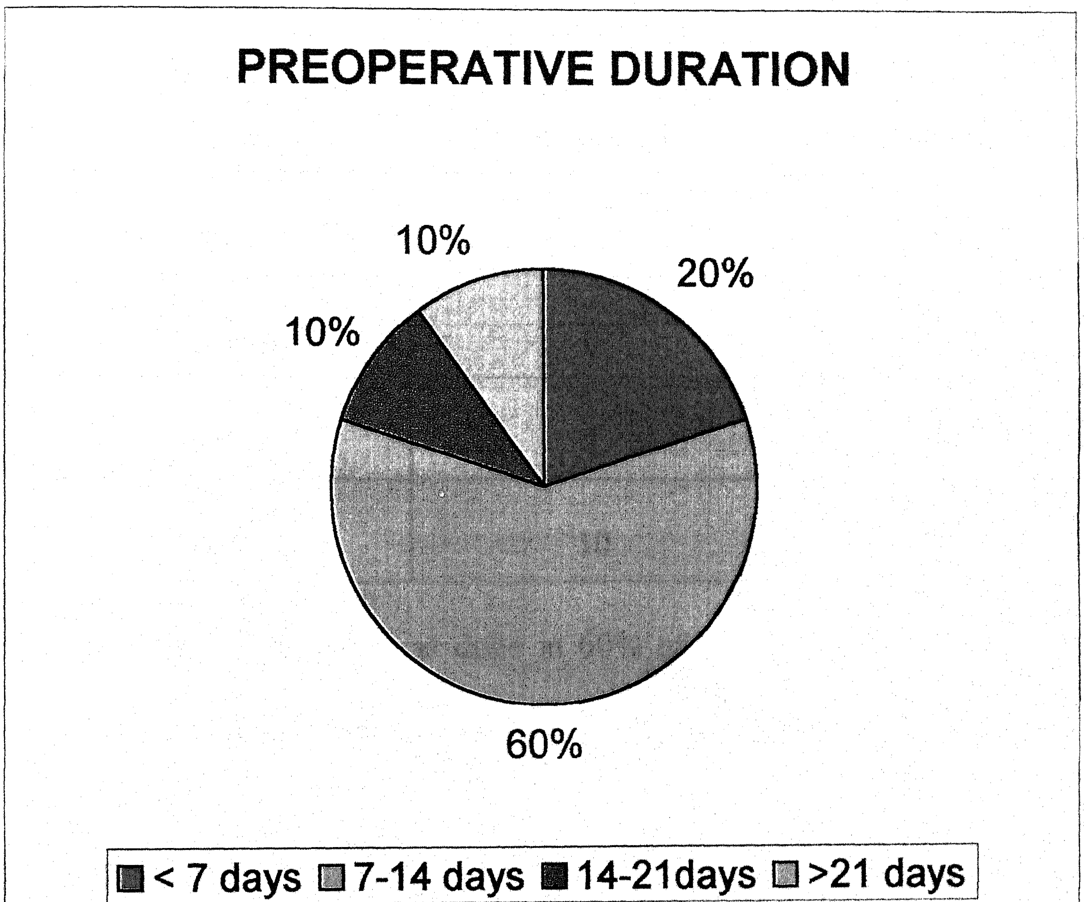

PREOPERATIVE DURATION
10%
20%
10%
60%
< 7 days
7-14 days
14-21days
>21 days

TABLE –X

TYPE OF LOCKING

Type	Number of patients	Percentage
Static	3	30%
Dynamic	6	60%
Unlocked	1	10%
Total	10	100%

Dynamic nailing was done in 60% of cases. In 30% of cases static nailing was done while in one patient nail was left unlocked.

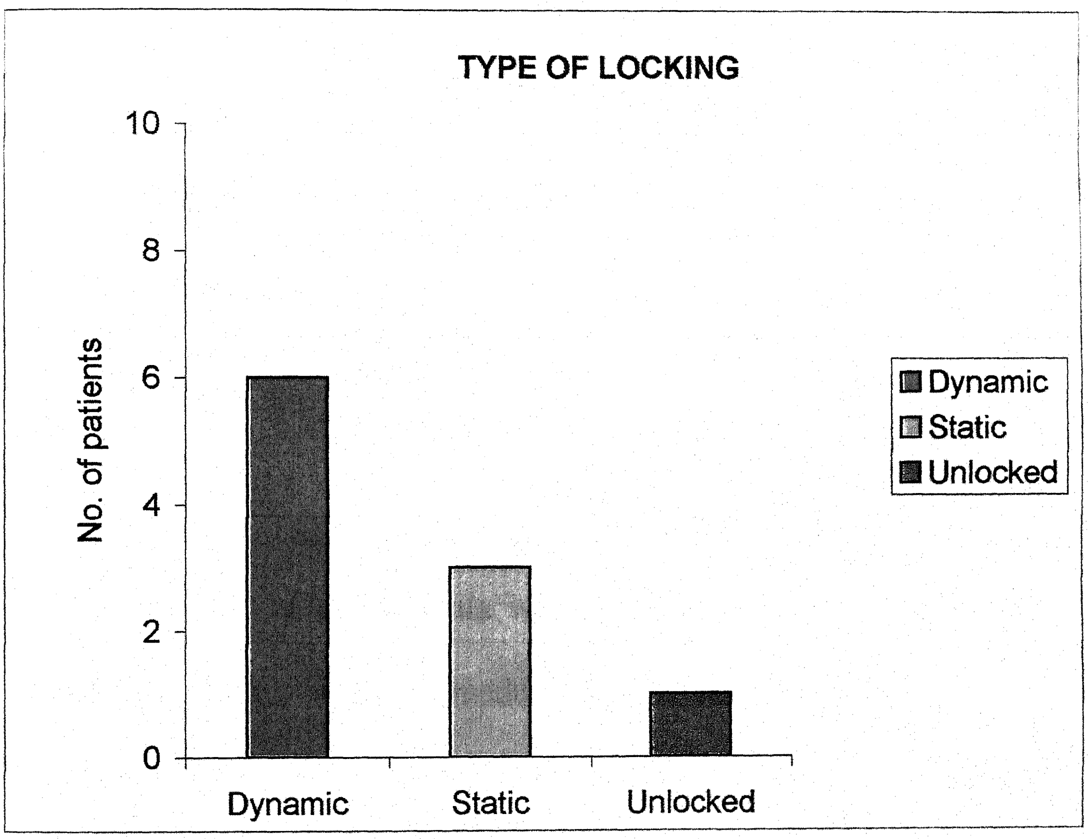

TYPE OF LOCKING
No. of patients
10
8
6
4
2
0
Dynamic
Static
Unlocked
Dynamic
Static
Unlocked

TABLE – XI

FIBULAR FIXATION

Fibular fixation	Number of patients	Percentage
Done	4	40%
Not done	6	60%
Total	10	100%

In 60% of cases fibula was not fixed while in 40% fixation was achieved either with intramedullary were or pin or using 1/3 rd tubular plate.

TABLE – XII

POST OPERATIVE HOSPITAL STAY

Post of hospital stay	Number of patients	Percentage
Less than 2 weeks	7	70%
More than 2 weeks	3	30%
Total	10	100%

70% of the patients were discharge before two weeks & only 30% of the patients stayed in the hospital for more than two weeks.

TABLE – XIII

PAIN AT FRACTURE SIDE

Status of pain at fracture site	10^{th} day	4 - 16 wks	20 wks
Present	3	1	0
Absent	7	9	10

Only one patient complained of pain at fracture site for a significant period of time. Rest had no pain.

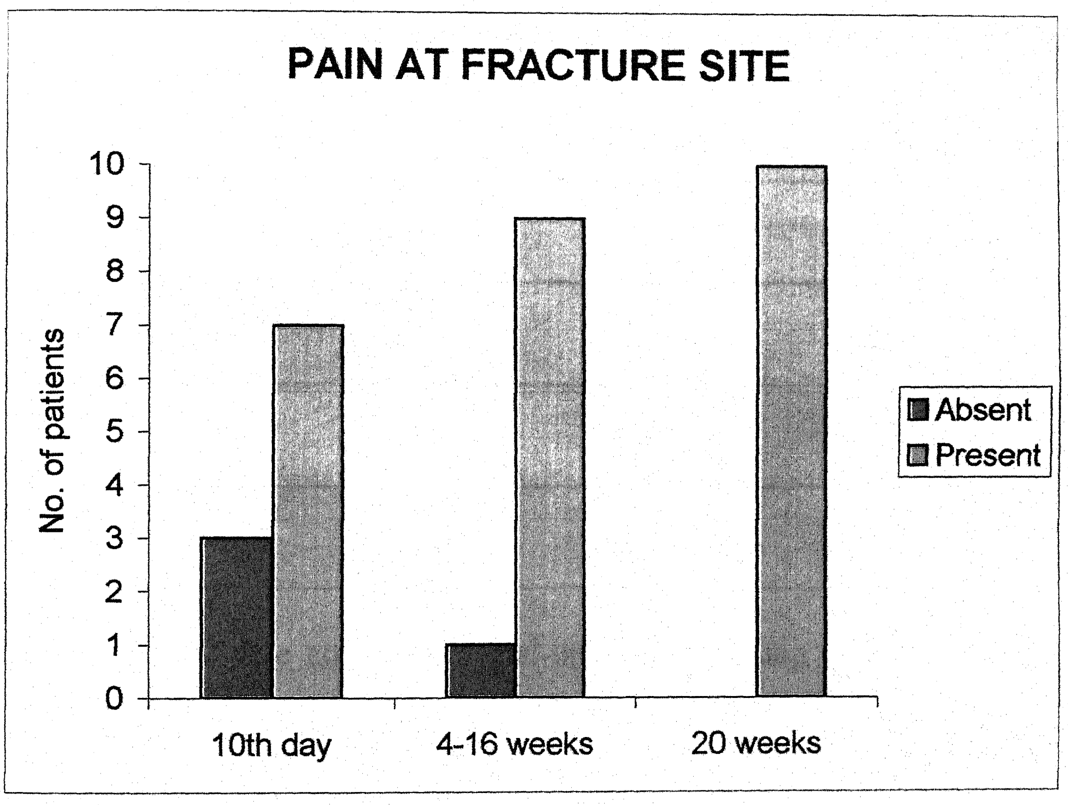

PAIN AT FRACTURE SITE
No. of patients
0
1
2
3
4
5
6
7
8
9
10
10th day
4-16 weeks
20 weeks
Absent
Present

TABLE – XIV

DEFORMITY & SHORTENING IF ANY

		Number of patients	Percentage
Deformity	Present	0	0%
	Absent	10	100%
Shortening	Present	1	10%
	Absent	9	90%

There were no cases of mal-union. Shortening of around 1 cm was present in one patient.

TABLE – XV

INFECTION

Infection		Number of patients	Percentage
Superficial	Present	2	20%
	Absent	8	80%
Deep	Present	0	0%
	Absent	10	100%

There were no deep infections while superficial infection developed in two patients, which cleared with dressings and antibiotics.

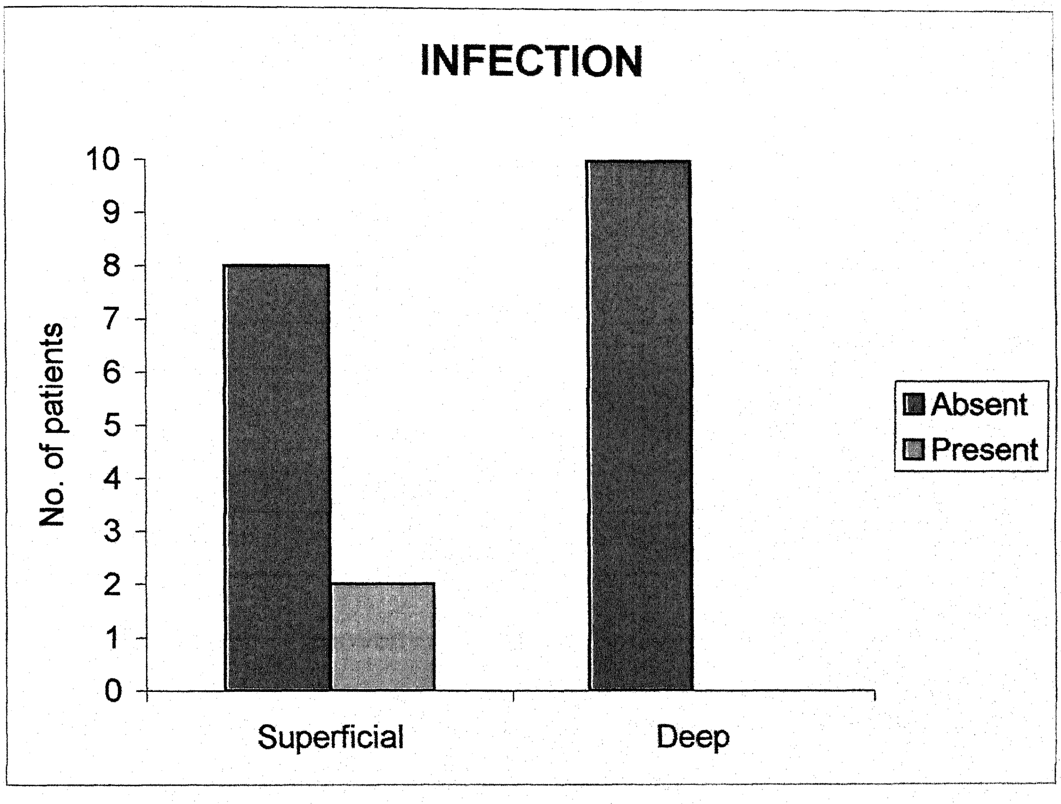
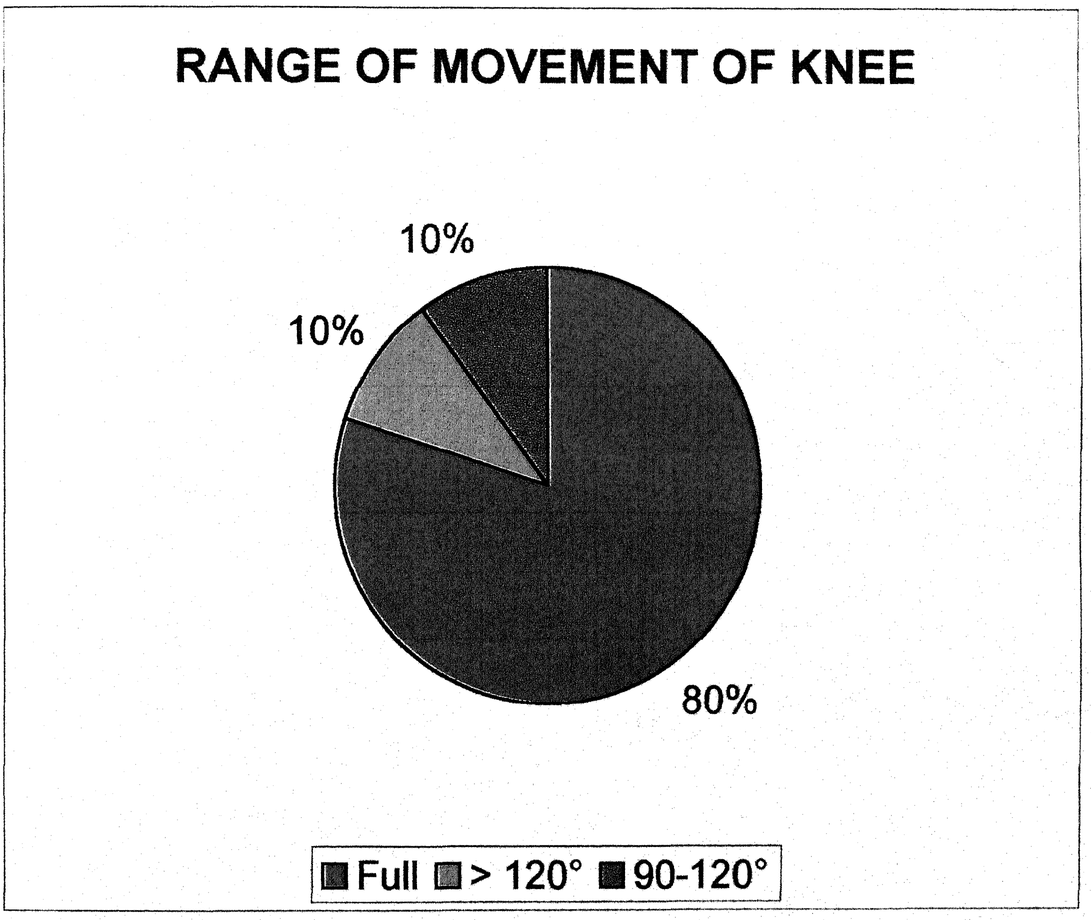

INFECTION
No. of patients
10
9
8
7
6
5
4
3
2
1
0
Superficial
Deep
Absent
Present

TABLE – XVI

RANGE OF MOVEMENT

Joint	Range of movement	No. of cases	Percentage
Knee	Full	8	80%
	> - 120 °	1	10%
	90-120°	1	10%
Ankle	Full	9	90%
	< - 20°	1	10%

Full range of movement at knee joint was present in 80% of patients and at ankle joint 90% had full range of movement.


RANGE OF MOVEMENT OF KNEE
10%
10%
80%
Full
> 120°
90-120°

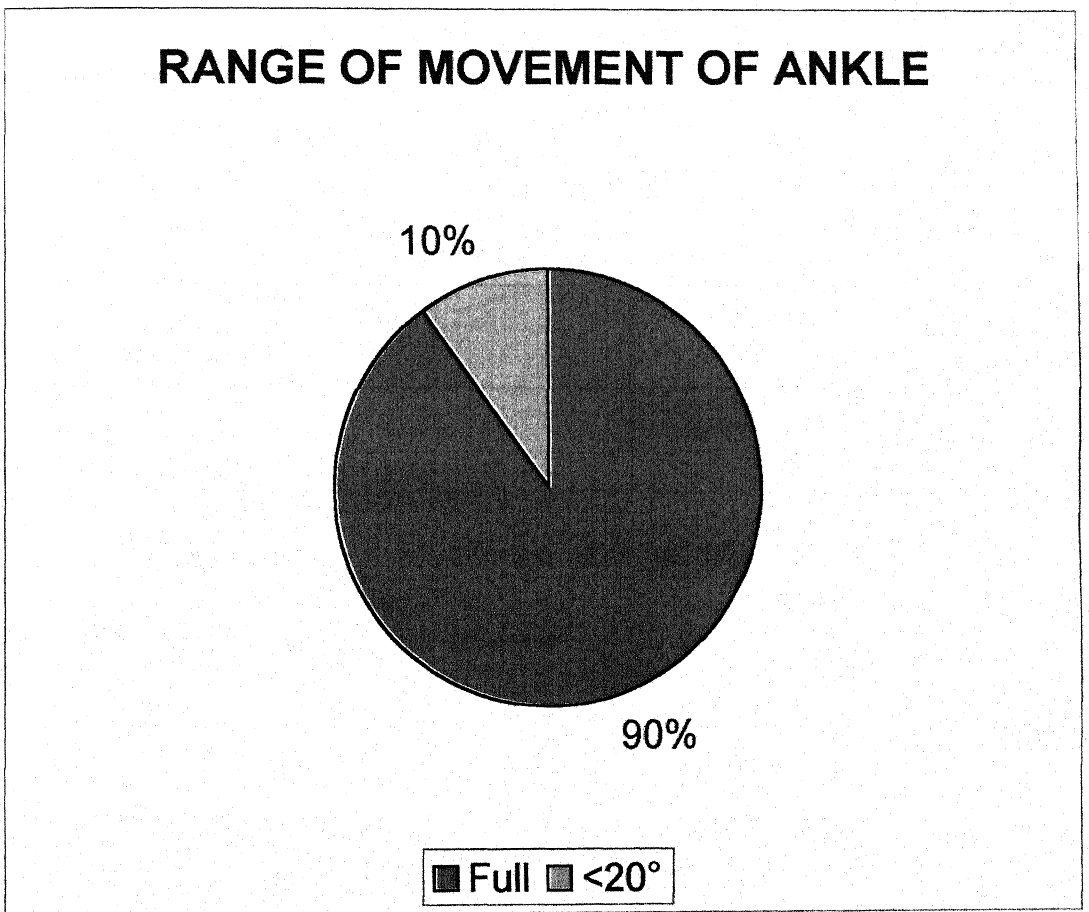

RANGE OF MOVEMENT OF ANKLE
10%
90%
Full
<20°

TABLE – XVII

STATUS OF UNION

	Time taken	No. of patients	Percentage
Union achieved	16 weeks	8	80%
	20 weeks	2	20%
Non union		0	00%
Total		10	100%

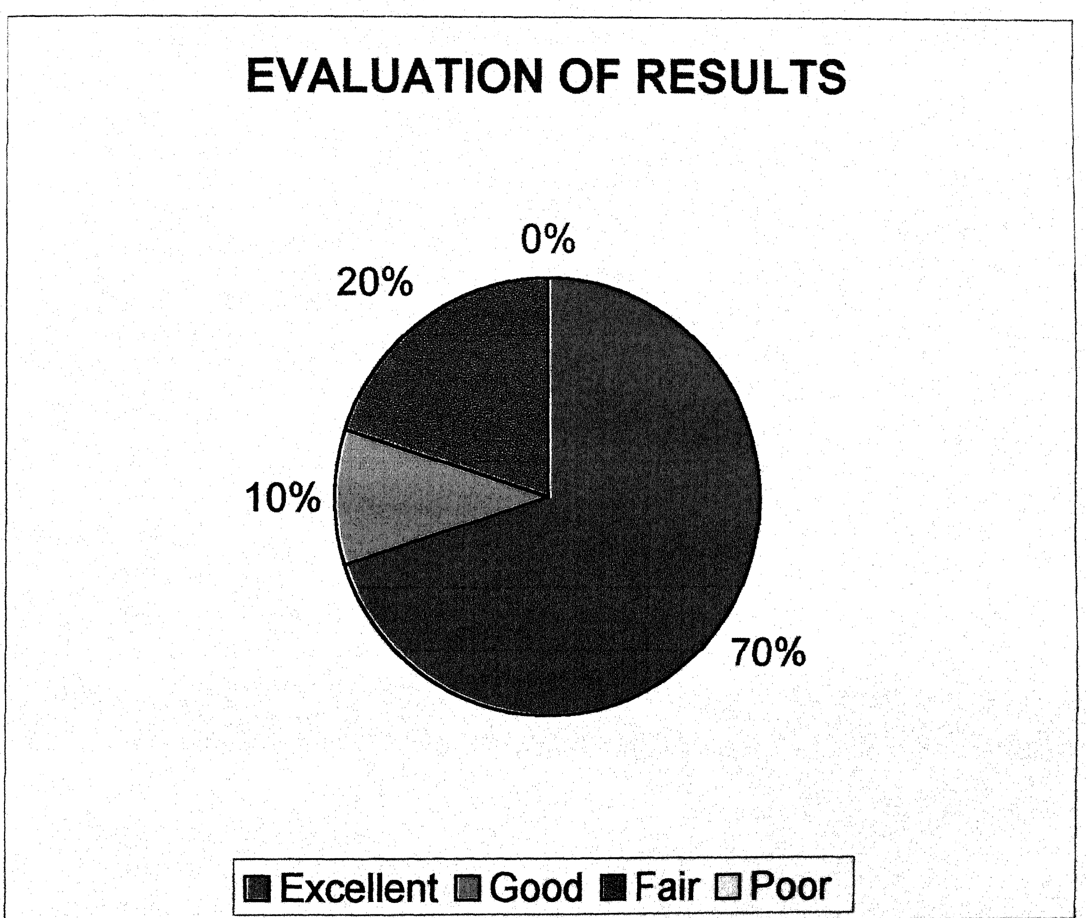
There were no non-unions. 80% of fractures united by 16 weeks while in 20% union was achieved by 20 weeks. Mean time taken is 16.8 weeks.

TABLE – XVIII

EVALUATION OF RESULTS

Criteria	Number of patients	Percentage
Excellent	7	70%
Good	1	10%
Fair	2	20%
Poor	0	0%
Total	10	100%

80% had good or excellent results with no poor results.


EVALUATION OF RESULTS
0%
20%
10%
70%
Excellent
Good
Fair
Poor

Photographs

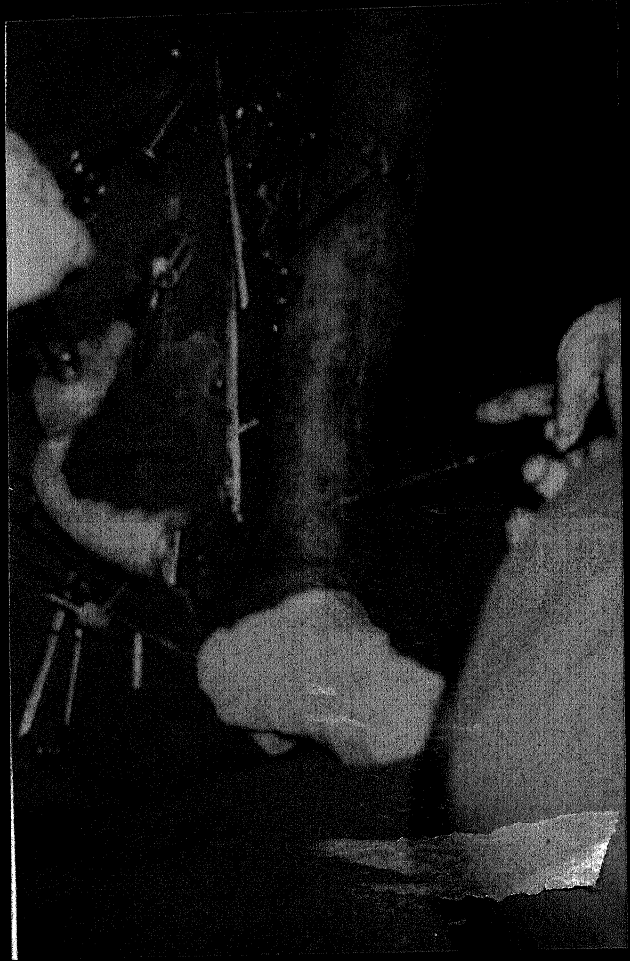
Photograph of implants and instruments
used in Daga nailing

Photograph showing patient on operation table after painting and draping.

Photograph showing skin incision.

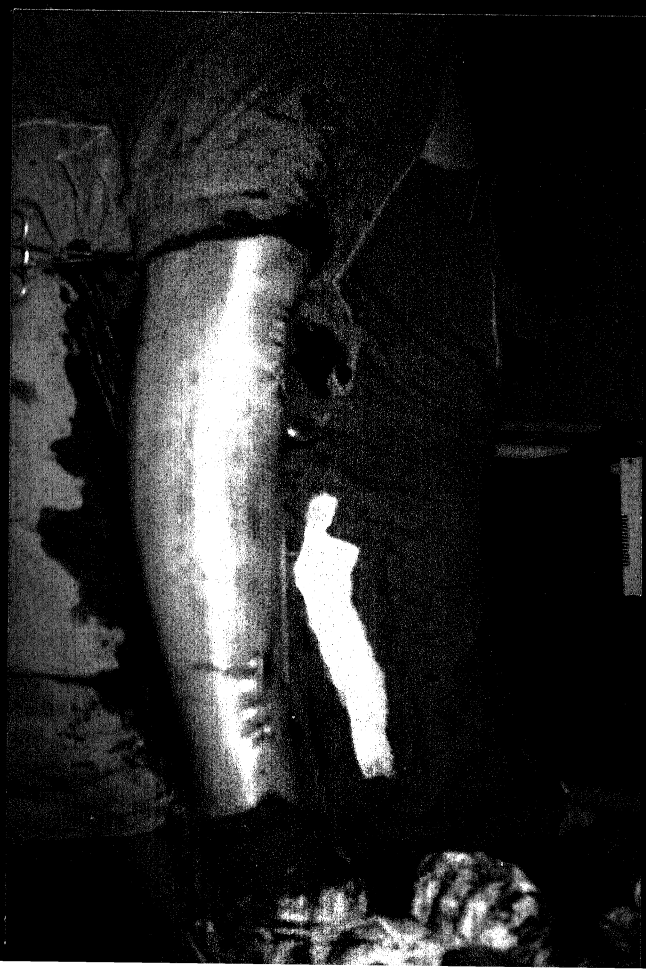
Photograph showing creating a window to establish entry portal.

Photograph showing insertion of Daga nail.



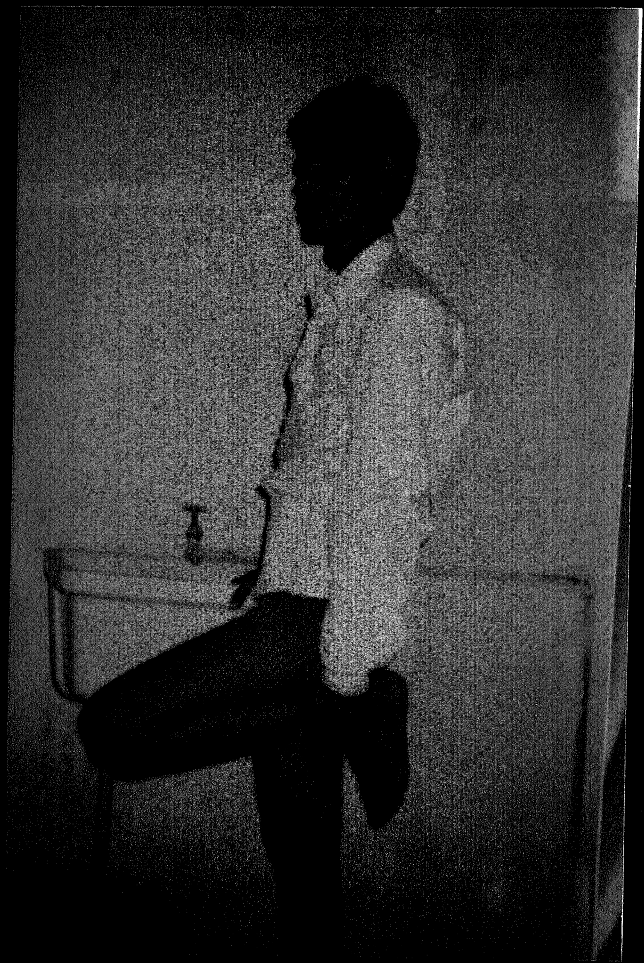
DISTAL LOCKING

Photograph showing closure of incision.



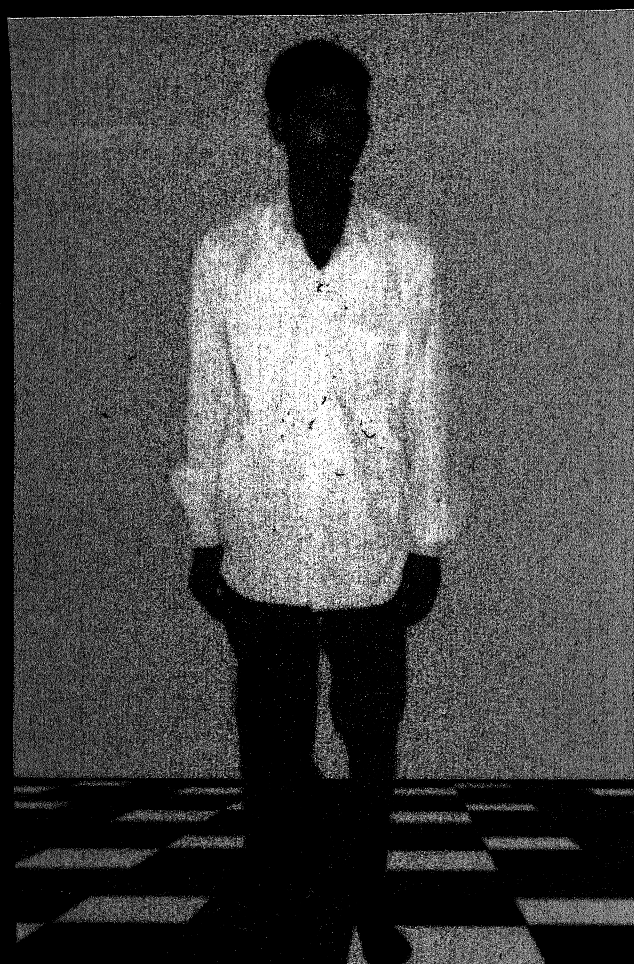
PHOTOGRAPH SHOWING PRE-OP X-RAY OF PATIENT

Photograph showing
post-op x-ray of a patient.



Photograph showing full weight on affected limb.

Photograph showing range of movement of knee and ankle



SAME PATIENT ON BOTH FEET

Photograph showing healed incision.

APH SHOWING 'PRE-OP X-RAY OF PATIENT

Photograph showing

post-op x-ray of a patient.

Photograph showing range of movement of knee and ankle.

Photograph showing full weight on affected limb.

Photograph showing healed incision.

DISCUSSION

DISCUSSION

The underlying is a brief comparison of various statistical date of present study with previous studies

1. ***Age –***

Range of patients age in present study varied from 16 years to 55 years with the mean age of 31 years & maximum number of patients (80%) between 20-60 years of age. In other series', also eg. **TYLLIANAKIS, M. et al** (2000) mean age was 39.8 years, **MANISCALCO et al** (2002); 42 years, **COLLINS, D.N. et al** 1990; 37 years, **ZHANG, D.H.; YANG, H.F.; ZHAN, R.S.** (2001); 32.8 years, **CM COURT BROWN et al** 1996; 35 years in reamed group & 36.1 year in unreamed group, **CM COURT BROWN** et al (1990), 39.1 years. In almost all the studies except **MANISCALCO** et al (2002) (in which mean age is 42years) the mean age varies between 30-40. The reason behind this similarity is that, people around this age group are the most exposed to trauma due to road traffic accidents. Also the incidence of assault injuries is also the highest in this age group. In a nutshell people in this age group lead an active life thereby exposing themselves to various nodes of trauma.

2. *Sex-*

In present study males predominate over females. The ratio lies at a high of 4 : 1 . 80% were male patients and only 20% were females. In other series e.g. **UHLIN, B.; HAMMER, R.** (1998) around 54.54% were male patients, **MANISCALCO et al** (2002). 71.42% were male patients; **ZHANG, D.H. et al** 76.31% were male patients.

COURT BROWN, C.M. et al 1996, 78% were male patients in reamed group while 68% were in unreamed group, **COURT BROWN, C.M. et al** 1990 around 79.48% patients were male. In present series had the maximum number of male patients as compared to other series. The reason behind this is the fact that women in Indian culture remain indoor most of the time and only males are involved in outdoor activities this they are more exposed to trauma.

3. *Mode of injury-*

In present series around 70% injuries were the result of road traffic accidents. **GREGORY, P.; SANDERS, R.** (1995) reported 53% injuries due to road traffic accidents. **COURT BROWN** et al 1990

reported 66.6% injuries due to RTA in their series. Increased number of road traffic injuries in present study is probably due to lack of proper administration and citizens also do not follow traffic rules strictly. Moreover quest for high speed also explains the observation that road traffic accidents are contributing to major percentage of trauma.

4. ***Open/Closed fractures –***

In present series 60% fractures were closed fractures while 40% were open fractures. In other series such as **WISS, D.A.; STETSON, W.B.** 1995, 24.62% fractures were open fractures, **UHLIN, B.; HAMMER, R.**, 1998, reported 21.82% open fractures, **COLLINS, D.N. et al** 1990 reported 20.46% open fractures, **HARRINGTON, P. et al** 1996 reported 34.10% open fractures, **ZHANG, D.H. et al** (2001) reported 31.58% open fractures. More number of open fractures in present series is explained by the fact the majority of cases were due to road traffic therefore more energy is imparted to soft tissues which disrupt, removing the cover of the bone and exposing the fracture to external environment.

5. ***Segment of Bone involved –***

Maximum number, 50% of fractures in present series were in lower third of tibia . **COURT BROWN, C.M. et al** 1990 also reported 51/2% of fractures in lower third. **EKELAND et al** 1998 also reported 46.8% of fractures in lower third of tibia. The increased incidence of lower third fractures is explained by the fact that lower third of tibia is completely devoid of soft tissues i.e. it is subcutaneous in location and also the curvature of the bone deepens in this region.

6. ***Poly-trauma vs Single bone fracture –***

Associated injuries in present series were present in 30% of patients while in series of **ALHO H et al**, 1992, and **COURT BROWN et al,** 1996, report poly-trauma cases to be 19.8% and 14.4% respectively. Again the higher energy imparted to the body at the time of impact due to road traffic accidents results in poly-trauma with fractures of multiple bones.

7. ***Post operative hospital stay***

Most of the patients were discharged within two weeks of operation and all were discharge within three weeks. In present series average stay at hospital post operatively was 13.9 days.

HOOPER & COLLEAGUES 1991 reported average stay in hospital post operatively to be 11.7 days. The advantage of internal fixation is that the stay in hospital is reduced. This is evident by both of the above studies.

8. ***Range of movement of knee and Ankle joint***

In present series 80% of patients have full range of movement at knee joint at final follow up. One patient had around 130° of flexion and one had 100° of knee flexion. Ankle motion was normal in 90% of patients but in 10% it was restricted to less than 20°. **GREGORY, P.; SANDERS, R.** (1995), also reported normal range of movement at knee and ankle except in those who had concomitant injuries. **COLLINS, D.N. et al** 1990 also reports normal knee and ankle motion in 93.18% with restricted movement in 6.81% of patients. **COURT BROWN, C.M. et al** 1996, also reported normal range of movement at knee and ankle joint. They reported 7.2% of ankle stiffness. In present series, post operative immobilization was done by PTB cast in one patient and the other had associated injuries which contributed to decreased range of motion.

9. ***<u>Deformity if any –</u>***

In present series there was no case of valgus, varus, anteroposterior or rotational mal-union. **MANISCALCO et al** (2002) report 5.35% incidence of mal-union greater than 5°. **COLLLINS, D.N. et al,** 1990 also report that there was no case of mal-union. **BOSS, N. et al** 1989 also report no mal-union while **HARRINGTON et al** 1996, report 2.27% of mal-union. In present series there was no mal-union as present in certain series showing that stability and strength of this nail is greater than similar nails.

10. ***<u>Infection –</u>***

There were no cases of deep infection in present series and in two patients 20% had superficial infection, which healed after antibiotic therapy and dressings. **WISS, D.A.** et al 1995 also report around 9.7% infection rate. **COURT BROWN, C.M. et al** 1990, report 1.6% incidence of infection. **GREGORY, P. et al** report 2.6% superficial and 2.6% deep infection. **MANISCALCO et al** 2002 also reported no case of infection. **COLLINS, D.N. et al** report 2.27% deep infection and 1.13% superficial infection. **BOSS, N. et al** 1989 report no cases of deep infection but report 18% complications rate in the form of superficial infection.

HARRINGTON, P. et al 1996 also reported no incidence of infection. **ANGLISS, R.D. et al** 1996 report 1.5% incidence of deep infection. **DARDER GARCIA, A.** 1998 report around 7.5% rate of deep infection. **EKELAND, A. et al** 1988 report 2.22% both superficial and deep infection rates while **ZHANG, D.H. et al** 2001 report 2.63% incidence of superficial infection with no incidence of deep infection. **COURT BROWN et al** 1996, reported no incidence of deep or superficial infection. The incidence of deep infection is equal to other series tested above. Superficial infection developed in 20% of cases, which is on a higher side as compared to other series but in all the cases it cleared off with antibiotics and dressings.

11. ***Status of union :***

In our series all the fractures united within, 20 weeks with average being 16.8 weeks. Union time averaged 16 weeks in series of **EKELAND et al**. **DAGA** in his series report average time to union to be 12 weeks. **'O' DWYER** 1995 in their series report it to be 15.2 weeks. **UHLIN B** et al 1998 reported that average time to union is 17 weeks, **WISS DA STETSON WB** 1995 reported that union time in their series is 28 wks. **COURT BROWN CM** et al

1990 show average time to union was 16.7 weeks. **MANISCALCO et al** 2002, reported average time to union was 16 weeks. **TYLLIANAKIS M et al** 2000, **HARRINGTON P, et al** 1996; **ANGLISS, R.D. et al** 1996; **DARDER GARCIA et al** 1998, **EKELAND, A. et al** 1988; **ZHANG, D.H. et al** reported average time to union was respectively 17 weeks, 15.3 weeks, 24 weeks, 16 weeks and 24 weeks. Patients in our series had a better and faster union rate with no non-unions.

12. Evaluation of results

In present series 80% of patients had excellent to good results while 20% had fair results with no poor results. **EKELAND et al** 1988 has reported 93.33 excellent to good results 4.44 good results and 2.23 poor results. **ALHO et al** 1990 reported 2% poor results, **TYLLIANAKIS, M. et al** 2000 report excellent results in 86.3% patients while **BOSS, N. et al** 1989 reported 96% excellent or good. Results in our series were comparable to those of other series.

CONCLUSION

CONCLUSION

1. Maximum number of fractures in tibia occurred in the age group 11-40 years with mean age approximately 31 years, reason being this age is the age of maximum adult earning and mobility.

2. Maximum percentage of the tibial fractures, are in male patients, 80%. The reason being in Indian culture females usually stay at home and males are engaged in out door work.

3. Maximum cases in present series were due to road traffic accidents, 70%. Quest for high speed and newer generation automobiles with great accelerations have made road traffic accidents as a major contributor of trauma these days.

4. Maximum number of fractures is of comminuted type, 50%, which again shows the great amount of kinetic energy imparted to body in road traffic accidents.

5. Majority of fractures were in lower third of tibia, 50% followed by middle third, 40%, followed by upper third, 10%. Lower third is the most exposed part of tibia and little soft tissue envelope is present which can dissipate the kinetic energy imparted to the bone.

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